

ECOLOGY OF *DISCARIA* (RHAMNACEAE) IN VICTORIA

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ABSTRACT: The general ecology of the two Victorian species of *Discaria* is described, especially that related to regeneration and conservation. *D. pubescens*, known from lowland basalt plains (Ballarat-Redesdale area) and from the Eastern Highlands, has been reduced to 24 stands, many of which are small and on private property. Fewer than one thousand plants are known from public land. Only 31 plants of *D. nitida* are known, all from the Eastern Highlands (Cobungra-Anglers Rest area).

Both species are shrubs, usually multi-stemmed, less than 3 m high. *D. pubescens* has a well-developed rootstock carrying stems which can be either cane-like or large and woody. *D. nitida* is totally deciduous in winter and *D. pubescens* nearly so.

In both, germination of fresh seed is increased greatly by nicking and even more so by cold-moist stratification for 30 days or more. High-altitude provenances responded more to long (60 and 90 day) stratification times than lowland ones. Some form of seed coat dormancy is inferred.

Alnus-type root nodules were common on *D. nitida* in the field but not on *D. pubescens*. Seedling inoculation trials produced some nodulation in both species, especially in low-nutrient treatments.

In burnt stands of *D. pubescens*, nearly all plants resprouted from rootstocks. Browsing of young shoots by cattle, sheep and rabbits or hares was recorded. Seedlings have not been seen in the field. It is suggested that seedling regeneration is hindered both by browsing and by suppression, especially by dense herbaceous swards following reduced fire frequencies. Active management, like fencing and reducing plant competition by slashing or burning, is urgently needed to encourage seedling regeneration.

The two Australian species of *Discaria* are regarded as rare Australia-wide (Briggs & Leigh 1987). Even though management will be needed to ensure that a representative series of their populations survive, almost nothing relevant is known of their ecology. This paper describes a brief project designed to provide an introduction to the ecology of both species in Victoria. The work was carried out from February to December, 1986. Species nomenclature follows Forbes *et al.* (1984).

The temperate Gondwanan genus *Discaria* (Rhamnaceae) is made up of five South American species, two from Australia and one from New Zealand (Tortosa 1983). All species are shrubs to small trees, usually with spines present and with dry, capsular fruits dehiscing explosively. Of the Australian species, *D. pubescens* (Brongn.) Druce is in that section of the genus characterized by corolla presence, while *D. nitida* R. Tortosa is in that with corolla absent (Tortosa 1983).

DISTRIBUTION AND HABITAT

Discaria pubescens

This species has not been recorded from Queensland since 1898 (Willis 1955) but still occurs in New South Wales, Victoria and Tasmania.

In Victoria west of Melbourne, of 12 recorded populations (Fig. 1), 8 are extant. However, these together contain only 52 plants of which only 12 are on public land (Lunt 1987). The altitude of these stands ranges from 220 to 460 m, mean annual rainfall from 520 to 740 mm and mean annual frost frequency from 10 to 35 days (Foley 1945).

Of the 16 extant sites east of Melbourne (Scarlett 1986; Fig. 1), we examined five and recorded 370 plants, 200

of which are on public land (Table 1). The altitude of the stands examined ranges from 700 to 1160 m and mean annual rainfall from 670 to 740 mm. The upper altitudinal limit known is 1400 m at Flour Bag Plain NW of Cobungra where a single plant was found (N. Scarlett, personal communication). Mean annual frost frequency would be at least 73 days (the value for Omeo) and normally higher (Foley 1945).

Of the other 11 eastern stands, there is a significant public land stand of about 100 plants reserved at Benambra Creek Cascades, but the remaining 10 stands are mostly very small ones and add only a further 55 plants on public land (Scarlett 1986), except for that adjoining the Cobungra private property site (Table 1) where the number of plants might run into hundreds (Scarlett 1986). However, these plants are unprotected by fencing against stock from the adjacent private land.

In the west, all records are from stream and river valleys (Lunt 1987). While some plants can be close to river banks where soils are often inundated, many are in upper parts of valleys well clear of flooding so the basis for restriction to valleys is not clear. While most eastern stands are also in such valleys, near Lake Omeo there are non-valley plants up to 1.5 km from the lake edge and between Omeo and Cobungra, scattered plants can be found on ridge crests and in other non-river-valley sites.

D. pubescens usually occurs in grassy open woodlands and forests some of which have suffered partial or complete tree removal (Table 1). In the west, associated eucalypts include *Eucalyptus camaldulensis*, *E. ovata* and *E. viminalis* and in the east *E. pauciflora*, *E. rubida* and *E. stellulata* (Table 1; Lunt 1987).

Weeds are most serious in the west and include *Ulex europaeus*, *Rubus fruticosus* sp. agg., *Genista monspesulana* and *Rosa rubiginosa*.

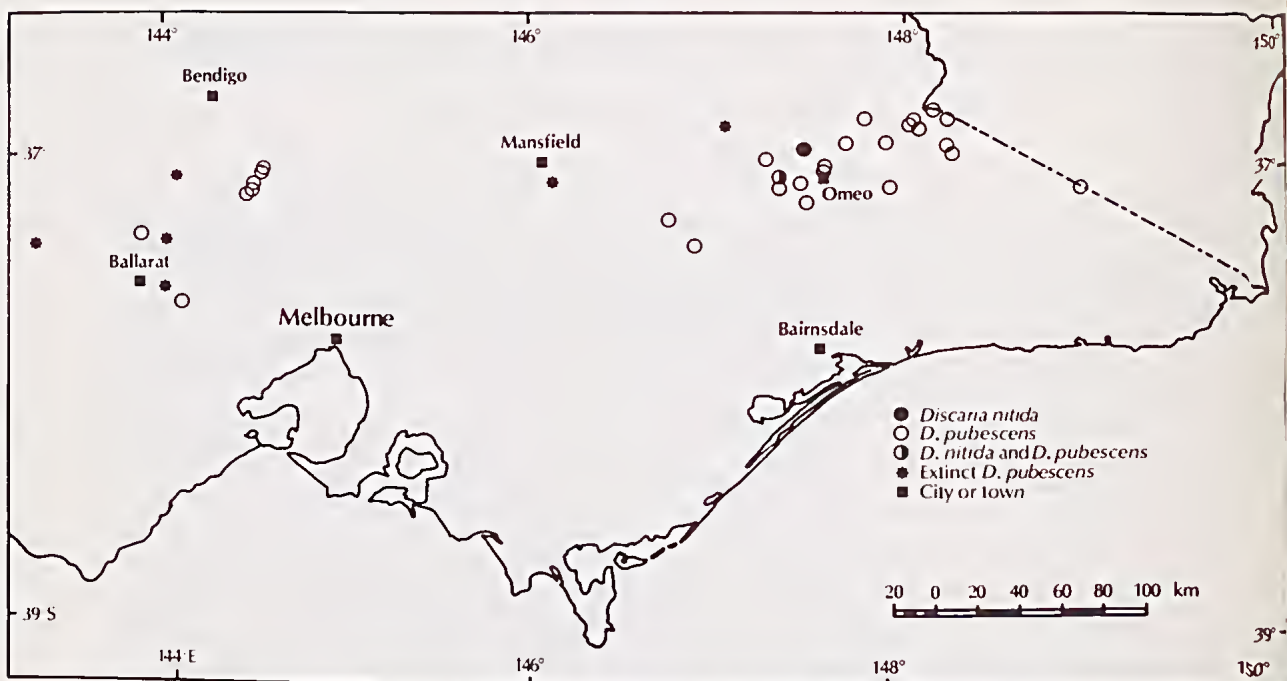


Fig. 1 — Past and present range of *Discaria pubescens* and *D. nitida* in Victoria. Partly after Scarlett (1986) and Lunt (1987).

Discaria nitida

When this species was described in 1977, it was known from two New South Wales locations and one Victorian one (Tortosa 1977; Table 1). Since then only one extra location has been found — a single plant on the Bundarra River, Victoria (Scarlett 1986), where further searching is desirable.

In Victoria, only 31 plants are known, of which no more than 5 are from public land. Altitude and climate are as for the Cobungra *D. pubescens* site (Table 1). No plants were found more than 5 m from a watercourse; we feel that all would receive supplementary water either from flooding or high water tables, so the species appears to be strictly riparian. At least two of the five South American species of *Discaria* 'show preference for riparian habitats' (Medan 1985) while the New Zealand species *D. toumatou*, like *D. pubescens*, is occasionally riparian (Daly 1969).

MORPHOLOGY

Discaria pubescens

This species is a densely-branched, spiny shrub 0.5 to 2 m high. In the west, plants can be multi-stemmed at ground level or can have a short main trunk. Old stems can be up to 15 cm in diameter (Figs 2&3). They carry younger, cane-like stems which are green except for their oldest parts and which often touch the ground, producing a roughly spherical crown (Fig. 4). In the east, the plants are usually multi-stemmed and no taller than 60 cm. We feel that the differences between east and west

are at least partly due to differing stem age due to fire and browsing history.

In mature plants, the well-developed tap root is surmounted by a subterranean, woody swelling carrying a number of horizontal, underground stems which do not bear roots. These stems in turn carry vertical canes (Figs 5&6). As it is not known what tissue the swellings are derived from, they are referred to here as rootstocks.



Fig. 2 — Base of large *Discaria pubescens* plant, Langley, Victoria, showing single main trunk and young lateral branches (L

TABLE 1
CHARACTERISTICS OF VICTORIAN *Discaria* SITES EXAMINED IN DETAIL
The first three sites are west of Melbourne.

Sites	Land tenure	Altitude (m)	Mean annual rainfall (mm)	Soil Parent Material	Topsoil texture	Plant community	No. of <i>Discaria</i> plants present
(a) <i>Discaria pubescens</i> Lal Lal Falls	Scenic Reserve	420	737	Basalt	Sandy clay loam	<i>Eucalyptus ovata</i> grassy forest with <i>Poa</i>	10
Creswick Creek	Private property	360	618	Basalt	Sandy clay loam	Cliff top adjoining <i>E. ovata</i> forest	4
Queens Falls	Private property	350	524	Basalt	Sandy clay	<i>E. camaldulensis</i> open forest with <i>Stipa</i>	11
Lake Omeo Cobungra	Crown Land Reserve Private property	700 1100	670 641	Granite Metamorphics	Sandy loam Sandy loam	<i>Themeda</i> grassland Semi-cleared grassy open forest with <i>Themeda</i>	33 50+
Wombargo	Public land: proposed national park	900	732	Rhyodacite	Sandy loam	<i>E. pauciflora-E. rubida</i> grassy open forest	100+
Native Dog Flat	Cobberas-Tingaringy National Park	1160	738	Limestone	Sandy loam	Edge of <i>E. stellulata</i> grassy open forest	40
Bendoc North	Private property	780	717	Slate, phyllite	Sandy clay loam	<i>E. pauciflora</i> grassy open woodland	117
(b) <i>Discaria nitida</i> Cobungra	Private property	1100	641	Metamorphics, alluvium	Sandy loam	<i>E. stellulata</i> shrubby open forest	23



Fig. 3—Base of large, multi-stemmed *Discaria pubescens* plant, Langley, Victoria. Diameter of left hand stem is about 15 cm.

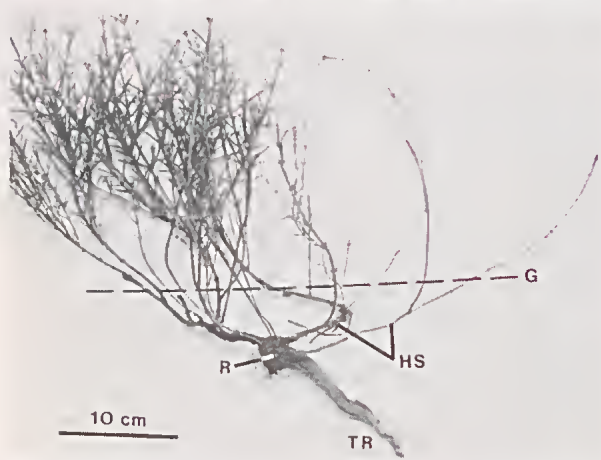


Fig. 5—*Discaria pubescens* plant from Native Dog Flat showing multi-stemmed habit at ground level (G), rootstock (R), tap root (TR) and horizontal underground stems (HS).

Discaria nitida

D. nitida is less-branched and with a more erect habit than *D. pubescens*. All plants seen were multi-stemmed, usually with 4-5 stems (Fig. 7). The stems are not cane-like; they do not remain green after the first season's growth. Before leaf-fall, the plants look noticeably leafier than those of *D. pubescens*, having larger leaves and smaller spines.

Very limited root excavation work suggests absence of tap roots or clear-cut rootstocks and no sign of the latter was seen on seedlings up to 5.5 months old.

PHENOLOGY

Discaria pubescens

Flowering times are from November to February (Briggs & Leigh 1985; C. Beardsell, personal communica-



Fig. 4—*Discaria pubescens* plant 1.5 m high at Hazeldene, Victoria, showing spherical canopy and much-branched shoot system.

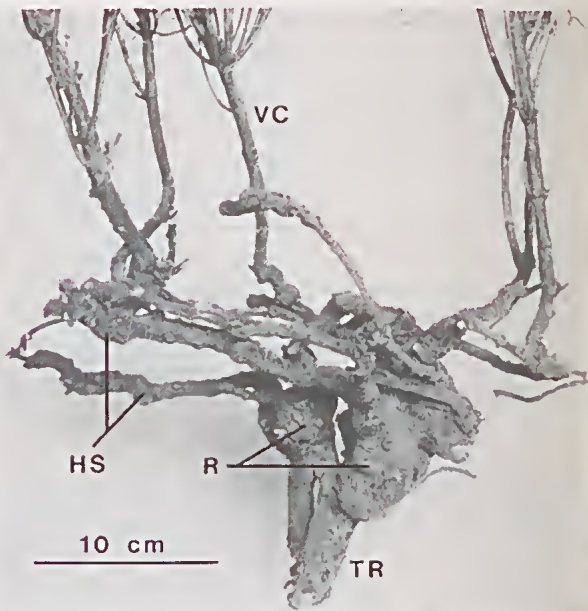


Fig. 6—*Discaria pubescens* plant from Lake Omeo showing rootstock (R), tap root (TR), horizontal underground stems (HS) and five main vertical canes (VC).

tion); only a single plant (at Cobungra) was still in flower when work started in mid-February. At this time, fruit maturation was complete and dispersal nearly so at the lowest altitude sites but not at those above 800 m (Table 2). The percentage of plants producing seed at the main sites varied from 11 to 60 (Table 2) but was 0 for the 11 Queens Falls plants. Flowers or fruits were never seen on the current season's growth.

Shoot elongation is not continuous; Lal Lal shoots tagged in mid-April had produced no growth by mid-September. Leaf yellowing and fall had begun in mid-April and continued until mid-July. However, plants in



Fig. 7—*Discaria nitida* plant 2.6 m high in July 1986 after leaf-fall, Victoria River, Cobungra showing multi-stemmed habit and riparian habitat.

the western sites did not become totally leafless, unlike those in the east. At Lal Lal, bud-burst was well underway by early August. Spines form on the youngest stems and persist for some years.

Discaria nitida

D. nitida flowers in November–December (C. Beardsell, personal communication) and capsule maturation is later than for *D. pubescens* (Table 2). While all capsules were immature in mid-February, most had already dehisced by mid-March 1986.

Plants were in full leaf in March and completely leafless by early July. The species is thus one of the few (maybe the only) truly winter-deciduous member of the Victorian native flora. In the same way, *D. toumatou* is one of the few deciduous New Zealand species (Daly 1969).

PERENNATION

Discaria pubescens

Although clumped and patchy distribution of plants in the eastern sites often suggested vegetative reproduction, excavation always indicated seedling origin.

Regarding longevity, Willis' (1955) photograph of 'three old yet vigorous' plants which still exist at Creswick Creek must mean a lifespan much longer than 30 years. Because annual stem growth increments could be identified on young stems by colour, diameter, branching se-

TABLE 2
FRUIT AND SEED DATA FOR *Discaria*, 13-20 FEBRUARY 1986
(Minimum sample size = 100 for fruits)

Site	% of fruits green and unripe	% of fruits dehisced	% of plants producing some seed in autumn 1986
(a) <i>Discaria pubescens</i>			
Lal Lal	0	70	30
Creswick Creek	0	90	60
Lake Omeo	0	90	11
Cobungra	70	10	26
Wombargo	70	10-20	42
Native Dog Flat	90	2	28
Bendoc North	0	80	20*
(b) <i>Discaria nitida</i>			
Cobungra	100	0	55

* Excluding the stand burnt in summer 1985-6.

quence and grouping of leaf scars, it was possible to show that stem growth rings are annual, at least in young stems, and to use them to determine stem age. The only large woody stem sectioned had 25 rings, while canes had from 1 to 6 rings. Similarly, *D. toumatou* in New Zealand may have tap roots 30 to 50 years old and stems 10 to 20 years old (Daly 1969) with some stems being over 100 years old (Daly 1967).

Discaria nitida

The few stems available for ring counting gave counts of 6 to 18 rings. Counts tended to be higher than for *D. pubescens* in keeping with the absence of cane-like stems. Much bigger stems were present than those counted.

SEED CHARACTERISTICS

Discaria pubescens

Seeds are shiny, light brown to dark brown, with mean weight 9.8 mg (Lal Lal site). Most seed is dispersed by explosive dehiscence while the capsules are still on the plant. Dispersal distance from such dehiscence for capsules collected from Native Dog Flat in February 1986 ranged from 33 to 178 cm, with a mean of 91 cm (methods of Medan 1985), compared with a maximum of 240 cm for South American species of *Discaria* (Medan 1985). This explosive mechanism was still efficient after seven months at 4°C once capsules reached room temperature. Similar mechanisms are known in other Rhamnaceae (Smith 1984).

Discaria nitida

The seeds are like *D. pubescens* in morphology and colour; mean seed weight (Cobungra) was 8.5 mg. Dispersal by explosive dehiscence appeared very similar to *D. pubescens* but was not quantified.

TABLE 3

PRE-TREATMENTS USED IN GERMINATION TRIALS OF *Discaria*

Symbol	Pre-treatment
C	Control
N	Testa nicked* on convex surface
A	Seeds soaked in 1M HCl for 24 h
30	30 day stratification at 5°C
60N	60 day stratification at 5°C then nicked (as above)
60	60 day stratification at 5°C
90	90 day stratification at 5°C

* Nicking was always deep enough to expose white embryonic tissue.

GERMINATION

METHODS

For both species, germination trials (Table 3) were set up less than two weeks after seed was collected from plants between mid-January and mid-March 1986. Seed surface sterilizing used treatments in the sequence: BP Comprox detergent (10 min); 70% alcohol (60 s); and, 5% sodium hypochlorite (10 min), separated by water rinses.

Cold-moist stratification in the dark was preceded by imbibition for 1 h. There were five replicates of 20 seeds per sterile petri dish on autoclaved Whatman grade 182 paper, kept moist with distilled water in a Zankel growth cabinet providing photon irradiance of $53 \mu\text{mol m}^{-2}\text{s}^{-1}$ (PAR) (fluorescent tubes + incandescent bulbs) with 16 h/20-25°C light cycle and 8 h/15°C dark cycle. Germination was scored daily for 140 days.

Limited data were obtained on viability of *D. pubescens* and *D. nitida* seed collected on 4 January 1985 and 28 February 1980 respectively and stored at room temperature without humidity control.

RESULTS

Discaria pubescens

In all cases, acid treatment (Table 3) produced appreciably less germination than the controls; the data are not presented here.

For all provenances, percentage germination of control seeds was lower than nicked seeds. Stratified treatments always produced more germinations than non-stratified ones, sometimes over 90% (Fig. 8).

For non-nicked, stratified treatments, increasing stratification time increased germination for eastern provenances (Cobungra, Wombargo) but had no significant effect on western provenances. The increased stratification requirement of the eastern provenances correlates with the higher altitudes and more severe winters there. Similarly, for the New Zealand *D. toumatou*, germination can be increased from five per cent (unstratified) to 80 per cent by stratifying for 16 weeks (Daly 1967).

For seeds stratified 60 days, subsequent nicking always resulted in lower germination than in non-nicked

seeds (Fig. 8). Nicking may somehow enhance losses due to fungal invasion. Stratification and nicking (60N) always produced more germination than nicking alone (N). Given that stratification can substitute for nicking in enhancing germination, we assume its effect is on the seed coat. While stratification could act by softening the seed coat (Murphy & Stanley 1975), this does not easily explain the lower germination in the nicked treatment than in the stratified treatments. Possibly inhibitors are present in the seed coat (Bewley & Black 1982) which are more effectively decreased by leaching during stratification than by nicking alone. Whatever the precise dormancy mechanism, it is clear that an appreciable number of fresh seeds have impermeable coats as is common in other Rhamnaceae (Rolston 1978).

Number of days to reach 50 per cent of the final germination total ranges from 25 to 55 days for the nicked treatment but never exceeds 10 days in stratified treatments; germinability and germination rate were positively correlated. In stratified treatments, all germination had ceased by 35 days.

The seeds collected on 4 January 1985 gave 18% germination in treatment 30, thus showing some seed longevity of more than a year.

Discaria nitida

Response to treatment was similar to *D. pubescens* with very low germination of controls, a strong response to nicking and a stronger response to stratification up to at least 90 days (Fig. 8).

Of the 200 seeds from 1980 tested, 2 per cent germinated, establishing seed longevity of at least six years but showing declining viability with time.

SEEDLING MORPHOLOGY

Discaria pubescens

Germination is epigeal and cotyledons are orbicular shiny and thick. Seedling leaves are serrate, oblong to ovate and in opposite pairs. Spines are absent from the first three leaf pairs. They first appear at 7-9 weeks, are always axillary and sometimes bear a leaf pair near their tip. Lateral branching is most common in the cotyledonary nodes and the lowest, spineless leaf nodes. A distinct tap root is present.

Discaria nitida

Similar to *D. pubescens* except that the cotyledons are ovate rather than orbicular, leaves are shinier, larger, less serrate and elliptic to obovate, spines almost always carry a leaf pair near their tip and lateral branching is much less common.

NODULATION

As other members of the genus have nitrogen-fixing root nodules (Tortosa & Medan 1983, Daly 1969), these were searched for in the Australian species.

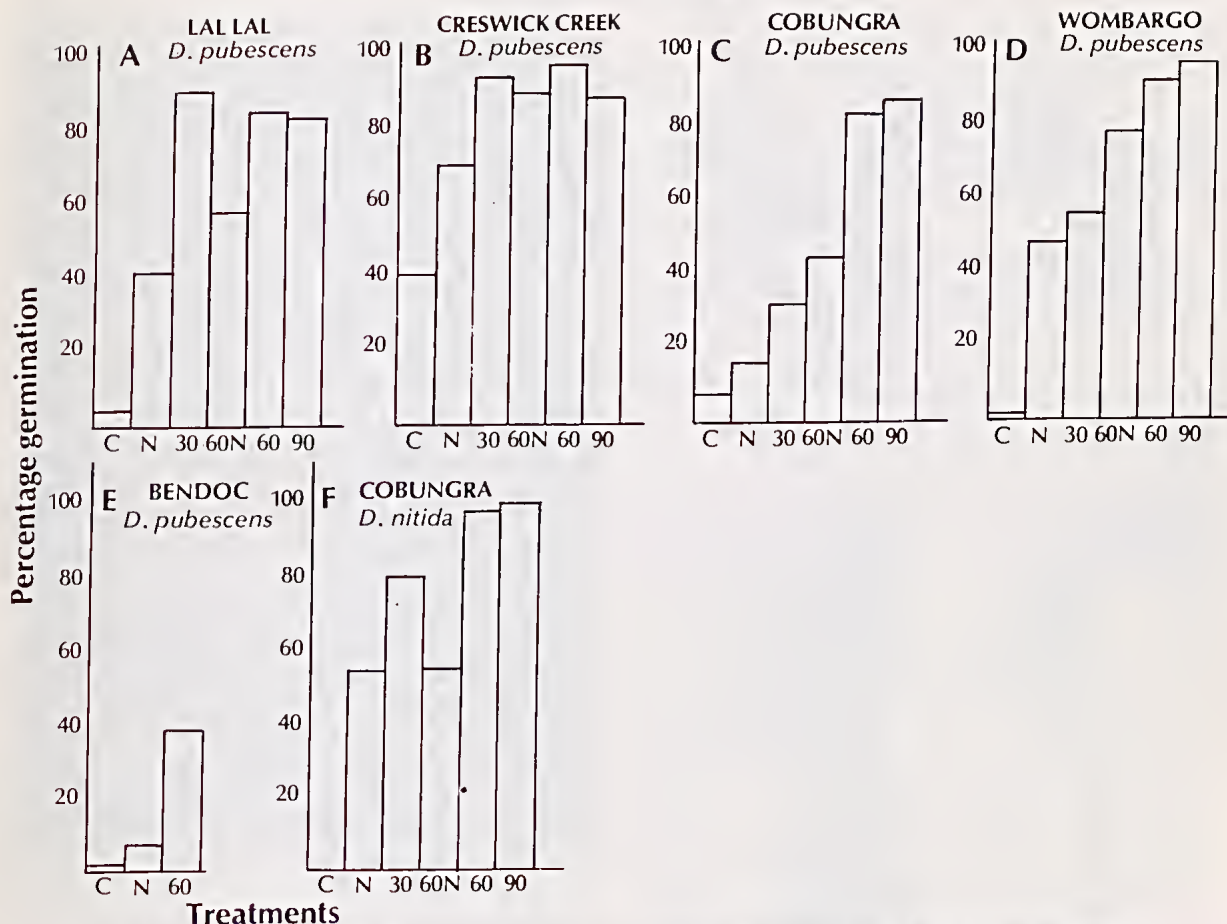


Fig. 8—Germination of two species of *Discaria* following six pre-treatments. See Table 3 for pre-treatment details.

FIELD OCCURRENCE

Extensive excavation around five western *Discaria pubescens* plants and 20 eastern ones did not reveal any nodules on roots of adult plants. No seedlings could be found for examination.

At the *D. nitida* site, all four plants examined showed profuse nodulation. Nodules (Fig. 9) were coralloid (*Alnus*-type) and of two forms; a dense, highly-bifurcate type known for other *Discaria* spp. (Medan & Tortosa 1976, Tortosa & Medan 1983) and the more elongate, less branched type characteristic of *Discaria* grown in water culture (Medan & Tortosa 1976).

In nodule sections, the endophyte was found in distended cells in the middle of the cortex, suggesting a *Frankia* symbiont as for five other *Discaria* species (Medan and Tortosa 1976).

INOCULATION TRIAL

Methods

For both species the inoculum was soil from 0 to 30 cm beneath an adult *D. pubescens* at Queens Falls. Ten per cent by volume of soil was added to a 1:1 mixture of washed river sand and perlite in 5×5×12 cm pots. Half the pots were autoclaved (the control treatment).

'No nutrient' pots received 40 ml distilled water daily. In addition, 'low nutrient' pots received 40 ml of 0.05 g/l 'Aqasol' weekly and 'high nutrient' pots 40 ml of 0.25 g/l 'Aqasol' weekly for the first four weeks increased to 0.5 g/l from then onwards. Growth cabinet conditions were as for the germination trials.

Young seedlings from the germination trials were planted one per pot; there were 10 replicates × 2 species × 6 treatments. For the pots inoculated with soil, discovery of *D. nitida* nodules in the field allowed for a crushed (pestle and mortar) nodule suspension (4.2 g/100 ml water) to be added (2 ml per pot) in week five. All plants were harvested and dry-weighted at 105°C after 12 weeks.

Results

A single nodulated *D. pubescens* plant (confirmed by sectioning), from the inoculated low nutrient treatment, provided the first record of nodulation in this species. More nodulation may have occurred if it has been possible to prolong the experiment.

Only three *D. nitida* seedlings were nodulated (Fig. 10), all from the inoculated no nutrient treatment, suggesting that nodulation can be correlated with nutrient stress as in other work (Medan & Tortosa 1976).



Fig. 9—Coralloid nodules from adult *Discaria nitida* at Cobungra, $\times 4$. A. Dense, highly bifurcate type. B, C. Elongate, less-branched type. D. Nodule on large root.

SEEDLING GROWTH RATE

Dry weights from the inoculation trial do not suggest any marked differences in growth rate between the species. Both species showed highly significant responses to both nutrient addition treatments; maximum shoot yields for 12 week old seedlings of both were in the range 100–120 mg. Inoculated pots usually produced lower yields than control pots, presumably due to some effect of autoclaving on nutrients or microbial ecology. Full data are held on permanent file at the Botany Department, La Trobe University (Hall 1986).

Shoot height growth data from an earlier growth cabinet trial used to document seedling morphology showed, for 16-week-old seedlings, significantly faster height growth for *D. nitida* (mean height 20 cm) than for *D. pubescens* (mean height for five provenances ranges from 9 to 15 cm). The lack of such a difference in the shoot dry weights of the two species (above) may partly be attributed to greater lateral branching in *D. pubescens*. Also, growth rate differences between the two may become more prominent after 12 weeks, when the dry weights were taken. The faster height growth of seedlings

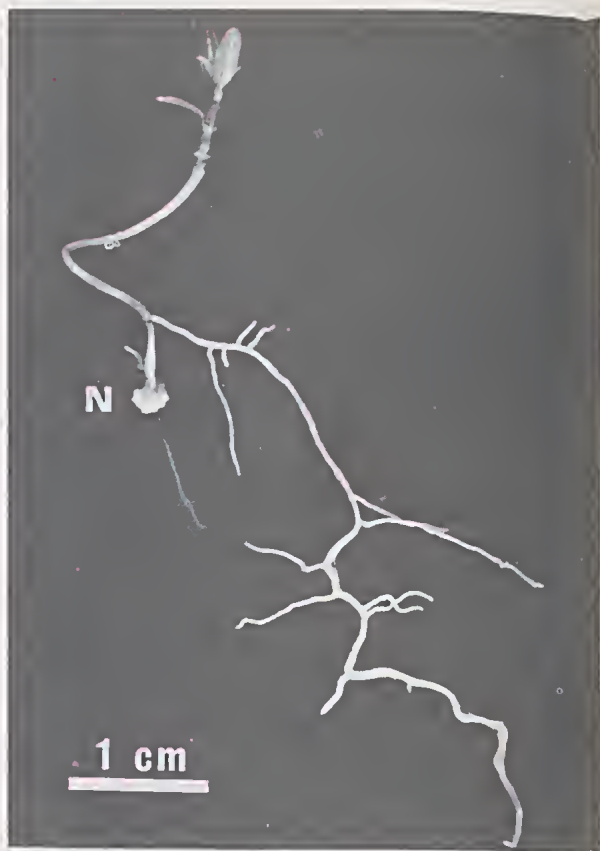


Fig. 10—*Discaria nitida* seedling 12 weeks old from Cobungra seed source showing nodule (N). Stunted growth of plant is due to no-nutrient treatment.

of *D. nitida* correlates with the taller, less-branched habit of adult plants.

RESPONSES TO FIRE AND BROWSING

Discaria pubescens

Part of the Bendoc North stand (Table 1) is subject to a deliberate, patchy, annual burn and was last burnt in November 1985. When seen in February 1986, rootstock resprouting after fire could be verified by occurrence of new shoots appearing from the top of the rootstock among dead, charred canes. Flowers, fruits and seeds were totally absent. Possibly, very frequent burning could hinder or prevent seed production and thus seedling recruitment and eventually eliminate the species.

The plot at Lake Omeo Crown Land Reserve, fenced from stock in 1982, was control burnt in May 1986. Before burning, the 33 *D. pubescens* present had a mean height of 54 cm. When seen on 6 December 1986, these shoots had been killed by the fire, but 29 plants had resprouted from the rootstock and had reached a mean height of 21 cm (range 1 to 45 cm). There were up to 27 new shoots per plant. Flower buds and flowers were absent, as was the case elsewhere on shoots less than a year old. Pre-fire, very few fruits were present on the few fer-

tile plants. Post-fire, no seedlings were seen but a dense herbaceous layer already made visibility poor.

Like the New Zealand *D. toumatou* (Daly 1967), *D. pubescens* may resprout following all but the very hottest fires. Burning itself may not constitute a serious threat, except for very frequent burning preventing seed production. It is not known whether fire in the autumn after seed shed could reduce or eliminate the dormancy imposed by the seed coat and thus assist regeneration.

During the present work, direct evidence was seen of browsing of young shoots by cattle at Lal Lal Falls (where shoots protrude through the fence), by sheep at Lake Omeo and by rabbits or hares at Bendoc North. As early as 1855, J. D. Hooker stated that the species was 'not common . . . much browsed on by cattle and sheep' (quoted in Willis 1955). From general field evidence and restriction of plants to areas inaccessible to stock, it is thought that browsing by rabbits and stock has strongly contributed to the present rarity of the species (Willis 1955, Briggs & Leigh 1985, Scarlett 1986).

Sheep are said to browse more heavily on *D. pubescens* than do cattle (D. Spencer, Cobungra Station, personal communication). New shoot growth (and presumably seedlings) is particularly sought after; new shoots can be restricted to the interior of *D. pubescens* crowns where they are protected by old and/or dead, spiny shoots further out. It follows from the greater palatability of new shoots that destruction of old plant tops by fire and subsequent resprouting can make a whole population temporarily more susceptible to severe browsing damage.

The New Zealand *D. toumatou* is similarly palatable to stock and rabbits, especially the young shoots (Daly 1969).

Discaria nitida

This species is regarded as more subject to browsing damage by cattle than *D. pubescens* following observations on severely-browsed specimens near Junction Plain, Victoria River, Cobungra area (Scarlett 1986). However, it is not known if its present rarity is due to browsing pressure.

REGENERATION FROM SEED

Discaria pubescens

Seedlings of this species have never been seen in the wild (this study; personal communications from I. D. Lunt, N. H. Scarlett and J. H. Willis). From the present work, it is unlikely that this is due mainly to problems of seed production or germination.

The seedlings are probably highly palatable to browsing mammals and this is likely to be part of the explanation in browsed areas. Also, field observations strongly suggest a relationship to density of associated vegetation. *D. pubescens* becomes rare then absent as tree density increases adjacent to open *D. pubescens* sites. It is rarely found directly under tree canopies and never under dense tall shrubs.

The correlation of *D. pubescens* with rather open areas (Willis 1942, Scarlett 1986, this study) in grassland, grassy woodland and along river valleys is reminiscent of *D. toumatou* which occupies similar sites (Daly 1969) and can also be clearly seral along shingle river-beds (Calder 1961). The high light requirement presumed for *D. toumatou* seedlings (Calder 1961, Daly 1969) may also be true of *D. pubescens*.

Young *D. toumatou* plants are readily suppressed by dense herbaceous swards (Daly 1969). The same may apply to *D. pubescens*, which may explain the absence of seedlings in some unbrowsed sites (Lunt 1987). Especially in western sites, which are fragments surrounded by long-settled farmland, declining fire frequencies may be a factor allowing dense grassy swards (including those of *Holcus* and *Phalaris*) to develop and to prevent *Discaria* seedling recruitment. Further, the observation that the best *D. pubescens* stands in the Cobungra area are on land lightly grazed by cattle rather than on nearby long-unburnt, almost ungrazed areas (Scarlett 1986) may be related to a similar effect.

Given that much of the biology of *D. pubescens* is so similar to that of *D. toumatou*, it is interesting that *D. pubescens* has declined in numbers and is now rare, while *D. toumatou* has increased so much that control measures are necessary. Seedlings of *D. toumatou* can be seen by the hundreds in spring (Daly 1967). The increase of *D. toumatou* is especially in areas where superphosphate has been spread aerially (Wardle 1985); this practice does not occur in *D. pubescens* areas. Otherwise, the reasons for the differing behaviour are unclear.

Discaria nitida

No seedlings or young plants were seen in the wild; again it is unlikely that this is due mainly to problems of seed production or germination. The conditions needed for seedling recruitment are unknown.

CONSERVATION

D. pubescens is rated as rare (3RCa) Australia-wide and is known from four biological reserves in New South Wales, one in Victoria and one in Tasmania (Briggs & Leigh 1987). Currently, *D. nitida* is also listed as rare (3RC-, Briggs & Leigh 1987). However, as nothing recent is known about population size or threats in the only reserve (Kosciusko National Park) and as the species is clearly endangered in Victoria, it is probable that the Australia-wide rating should be changed to vulnerable. The Victorian situation is exacerbated by loss of large parts of the banks of the Victoria River by accelerated soil erosion (Scarlett 1986).

In Victoria, for the western populations of *D. pubescens*, work is needed at the two public land sites (Lal Lal Falls and Turpins Falls) to ensure seedling recruitment. Removal of dense, grassy swards by slashing when *Discaria* seed is present is a suitable first step at both sites along with enclosure of the Turpins Falls plants by rabbit-proof fencing and enlargement of the minimal enclosure at Lal Lal.

The two most important western stands on private property are Queens Falls and Langley. These have the biggest western populations (Lunt 1987) and Langley has the largest plants and the biggest stem girths in Victoria. Conservation safeguards are urgently needed for both, given that the public land sites protect only 12 plants in all.

For eastern populations, the main Victorian stronghold for both species is the Victoria River-Spring Creek area on and adjoining Cobungra Station. While substantial numbers of *D. pubescens* occur on public land there, derelict fencing on the boundary with private property means that stock numbers on public land cannot be controlled. This, and the requirements for seedling establishment, need investigating. In the long term it may be necessary to securely fence the public land against stock and attempt to encourage seedling regeneration by burning when *D. pubescens* seed is present.

The stand of *D. nitida* is almost all on nearby private property which also carries plentiful *D. pubescens*; conservation safeguards are urgently needed for both. Such safeguards are also desirable for the other significant eastern stand of *D. pubescens* on private property, at Bendoc North, as it is sizeable, in native vegetation in good condition, appreciably disjunct from other stands and represents the south-eastern limit of the species on the mainland.

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